Center Innovation Fund: JSC CIF

An MMOD Risk Mitigation Technology for Spacecraft TPS

Completed Technology Project (2011 - 2013)

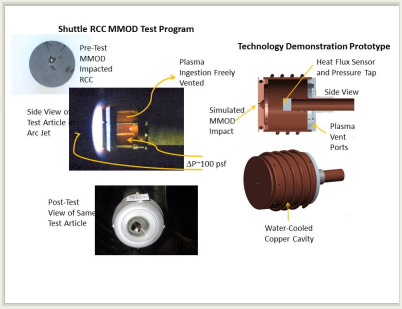
Project Introduction

The proposed project uses multiple and different types of sensors to detect high temperature plasma ingestion during atmospheric entry through a breach up to one-inch diameter in the Thermal Protection System (TPS) caused by an Micro-Meteoroid and Orbital Debris (MMOD) impact. Once high temperature plasma ingestion is detected during atmospheric entry, this technology can be automatically activated and uses consumables usually available on human-rated spacecrafts such as nitrogen (or helium) and water to (1) equalize the internal pressure to that of the external pressure across the breach to prevent high temperature plasma from penetrating the spacecraft and (2) maintain spacecraft structural integrity by keeping it within the temperature limits via an evaporative cooling effect.

This proposed technology uses nitrogen or helium gas and water to prevent structural damage that could lead to loss of vehicle and loss of crew caused by high temperature plasma ingestion through an MMOD impacted damage in the TPS. This results in "enhanced safety and probability of mission success for Entry, Descent, and Landing (EDL) phases of atmospheric flight." This technology uses heat flux, temperature, and pressure sensors from the Fault Detection Isolation and Recovery (FDIR) system to detect high temperature plasma ingestion. Thus, this system integrates gaseous nitrogen and water from the Environment Control and Life Support System (ECLSS) and the sensors from FDIR systems to automatically activate when necessary to mitigate the potential catastrophic hazard.

Anticipated Benefits

This proposed technology is a crosscutting technology that enables on-board vehicle systems management to detect a breach in the TPS during the critical entry phase and to autonomously activate the system to prevent plasma ingestion and to prevent structural failure that leads to loss of crew, loss of vehicle, and loss of mission. This proposed technology works autonomously, thus reducing earth-based mission ops “back room engineering” requirements for distant mission support delay.



Project Image An MMOD Risk Mitigation Technology for Spacecraft TPS

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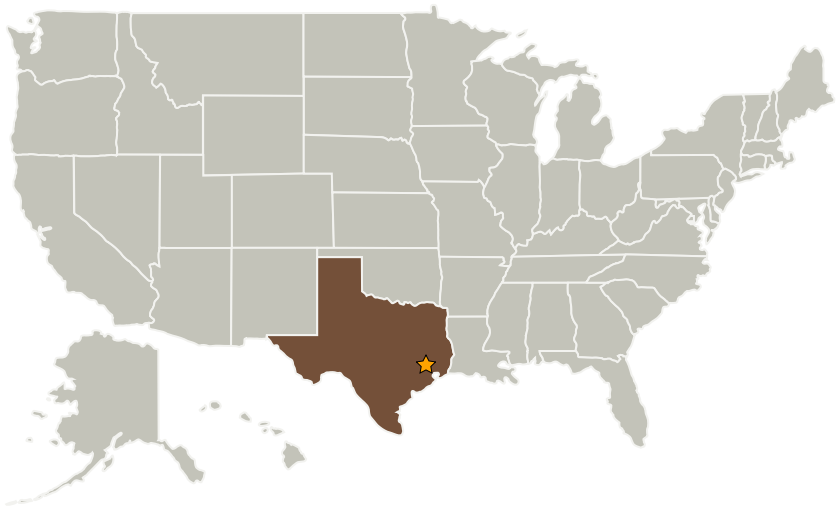
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★Johnson Space Center(JSC)	Lead Organization	NASA Center	Houston, Texas
Jacobs Engineering Group, Inc.	Supporting Organization	Industry	Dallas, Texas

Primary U.S. Work Locations
Texas

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Johnson Space Center (JSC)

Responsible Program:

Center Innovation Fund: JSC CIF

Project Management

Program Director:

Michael R Lapointe

Program Manager:

Carlos H Westhelle

Project Manager:

Vuong T Pham

Principal Investigator:

Vuong T Pham

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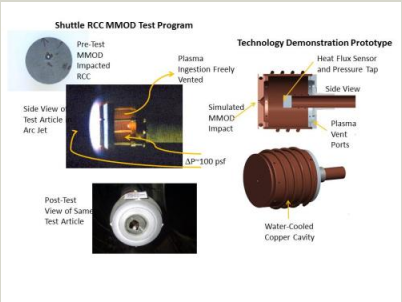
Images



12117-1376504576177.jpg
Project Image An MMOD Risk Mitigation Technology for Spacecraft TPS
(https://techport.nasa.gov/image/2215)

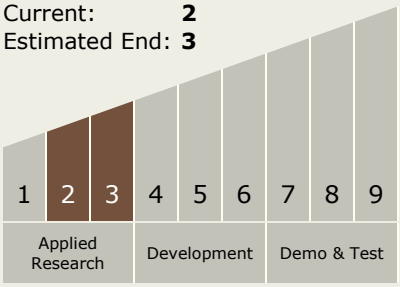
Links

Patent Link 1
(http://Waiting for the results of the demonstration test scheduled in September 2013 at JSC's Arc Jet Facility)

NTR 1
(http://NTR MSC #: MSC-25369-1)

Technology Maturity (TRL)

Start: **2**
Current: **2**
Estimated End: **3**



Technology Areas

Primary:

- TX14 Thermal Management Systems
  - TX14.3 Thermal Protection Components and Systems
    - TX14.3.5 Thermal Protection System Instrumentation